IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Amnon Naamad et al.	Art Unit	: 2651
Serial No.	: 10/081,682	Examiner	: Pierre-Michel Bataille
Filed	: February 25, 2002	Conf. No.	: 2103
Title	: MANAGEMENT OF INVALID TRACKS		

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF SECOND SUPPLEMENTAL BRIEF ON APPEAL

In response to the second notice of non-compliant appeal brief, Applicant submits a second supplemental appeal brief that remedies the deficiencies indicated in the notice.

This second supplemental appeal brief differs in section (6) which recites the grounds for rejection for claims 5, 9, 21, and 28 in a manner believed to be consistent with Rule 41.37(*c*)(*vi*).

Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 9-10-07

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SUPPLEMENTAL BRIEF ON APPEAL

(1) Real Party in Interest

The real party in interest is EMC Corporation, a corporation of Massachusetts having a place of business at 171 South Street, Hopkinton, Massachusetts, as evidenced by an assignment executed February 20, 2002 and recorded at the U.S. Patent Office on February 25, 2002 at Reel 012638, Frame 0274.

(2) Related Appeals and Interferences

There are no related appeals or interferences.

(3) Status of Claims

Claims 1-29 are pending on appeal.

(4) Status of Amendments

All amendments have been entered.

(5) Summary of Claimed Subject Matter

The last paragraph (lines 28-30) on page 5 describes a cylinder as being made of tracks. These tracks correspond to "constituent data storage elements" in claims 1, 13, and 25. Any cylinder corresponds to the "data storage unit" in claims 1, 13, and 25.

As discussed in the first paragraph (lines 1-7) of page 5, data in a track can be corrupted. Thus, a track can exist in either a corrupted state, in which it contains corrupted data, or an uncorrupted state, in which it does not. These are the states ("a first state and a second state") referenced in claim 1's preamble and also in claim 13's preamble.

The "data structure" of claims 1, 13, and 25, which is shown as data structure **32** in FIG. 2, is described in the third paragraph (lines 18-23) of page 5, as having "elements" corresponding to a set of tracks. Any one of these elements of this data structure could correspond to the "entry" in claims 1, 13, and 25.

Claims 1, 13, and 25 require that each of these entries correspond to one of the data storage units. Therefore, to the extent a "data storage unit" is a cylinder, each "entry corresponding to said data storage unit" would correspond to one cylinder.

According to page 5, fourth paragraph (lines 24-27), each entry in the data structure **32** can be in one of two states. These are the first and second states in claims 1, 13, and 25. Information about the state of entry is thus the "status information" in claims 1, 13, and 25. As discussed in the same paragraph, the status information indicates whether one of the data storage elements (i.e. tracks) in the data storage unit (i.e. cylinder) corresponding to a particular "entry" of the data structure **32** entry has corrupted data.

Page 6, first paragraph (lines 1-4) further describes an embodiment in which the "data structure" **32** is a bitmap **40** containing "cylinder bits" **42**, each of which corresponds to a cylinder (i.e. "data storage unit" in claim 1) having constituent tracks (i.e. "constituent data storage elements" in claim 1). In this case, each such cylinder bit would be an "entry corresponding to a data storage unit" (i.e. cylinder) in claims 1, 13, and 25.

Page 6, paragraphs 2 and 3 (lines 5-18) describe maintaining the bitmap by setting or clearing a cylinder bit depending on whether one of the tracks in that bit's associated cylinder has bad data.

The "updating" step in claims 1 and 13 corresponds to changing the cylinder bit in response to detecting that the constituent tracks (i.e. "constituent data storage elements") of that cylinder bit's associated cylinder have changed state. In one case, if any one track in a cylinder has a set invalid bit, the cylinder bit must also be set. This is shown in FIG. 2, and described on page 6, second paragraph (lines 5-12). The converse occurs when invalid bits for all tracks ("constituent data storage elements" have been cleared. This is described in connection with FIG. 3 in the last full paragraph of page 6 (lines 19-27).

Claims 3, 6, 15, 18 and 26 recite the additional limitations of locking and unlocking the data structure before and after modifying the status information and unlocking the data structure after modifying the status information. This additional limitation is disclosed in steps **56** and **60** in Applicant's FIG. 2, and the accompanying description in the second paragraph (lines 5-12) of page 6. It is also disclosed in steps **68** and **76** in FIG. 3, and the accompanying description in the fourth paragraph of page 6.

Claims 5, 8, 20 and 27 recite the additional limitation of having a data storage unit be a cylinder and having the data storage element be tracks within the cylinder. Support for this limitation can be found in the last paragraph (lines 28-30) on page 5.

Claims 5, 11 and 23 recite the additional limitation of scanning a data structure to locate constituent data elements in the first state. This additional limitation is disclosed in FIG. 4, steps **84**, **86**, and **88**, and the accompanying descriptions thereof in the first full paragraph (lines 4-13) of page 7.

Claims 12 and 24 recite the additional limitation of detecting an entry in the data structure that indicates the presence, in the data storage unit associated with that data structure, of a data storage element in a particular state, and then scanning the data storage elements in the data storage unit to identify the data storage element in that state. These additional limitations are disclosed in FIG. 4, steps **84**, **86**, and **88**, and the accompanying descriptions thereof in the first full paragraph (lines 4-13) of page 7.

(6) Grounds of Rejection to be Reviewed on Appeal

1. Whether *Candelaria* anticipates claims 1, 13, and 25 under 35 USC 102(*b*).
2. Whether *Candelaria* anticipates claims 3, 6, 15, 18 and 26 under 35 USC 102(*b*).
3. Whether *Candelaria* anticipates claims 8, 20 and 27 under 35 USC 102(*b*).
4. Whether *Candelaria* anticipates claims 5, 9, 21, and 28 under 35 USC 102 (*b*).
5. Whether *Candelaria* anticipates claims 11 and 23 under 35 USC 102(*b*).
6. Whether *Candelaria* anticipates claims 12 and 24 under 35 USC 102(*b*).

(7) Argument

Candelaria

Candelaria teaches a system in which tracks are copied from a disk to a cache memory. Each track has constituent records. A host that wishes to modify a record in a particular track would then modify the copy of that record stored in cache, not the original copy on the disk. This reduces latency as experienced by the host. The disadvantage is that the modified copy exists only in a cache, and not on the disk.

Since the existence of the modified copy of a record in cache is tenuous, the *Candelaria* storage controller ultimately copies (i.e. "destages") modified records back to the disk. Rather then simply destaging all records, whether modified or not, *Candelaria* provides a way to identify which records are modified, and which are not. The track information block (TIB) provides a way to identify such records.

In *Candelaria*, the TIB for a particular track has entries for each record in the track. When a particular record is modified, the TIB's entry for that record is also modified. In particular:

> "[i]f a record has been modified, but not destaged to DASD, it is listed as a modified record in the TIB. Such records must be destaged during any recovery procedure to avoid data integrity problems"[1]

[1] *Candelaria*, col. 7, lines 25-28.

SECTION 102(B) REJECTION OF CLAIMS 1, 13 AND 25

Candelaria teaches a system that reads and writes data one record at a time. These records are organized into tracks. Each such track has an associated track information block. Each entry in this track information block corresponds to one of the constituent records within that track.

From the foregoing, it is natural to regard the recitation, in claim 1's preamble, of a

> "data storage unit that includes at least two constituent data storage elements"

as corresponding to a track because, consistent with claim 1, a track "includes at least two constituent" records.

In discussing column 8, lines 59-63, the Examiner states that

> "[t]he above lines [col. 8, lines 59-63] simply state that there is a cylinder-data-storage system that includes 'tracks' which denote at least 2 constituent storage elements."[2]

The foregoing statement makes it clear that the Examiner regards *Candelaria*'s "tracks" as corresponding to claim 1's "data storage units" and *Candelaria*'s "records" as corresponding to claim 1's "data storage elements."

Claim 1's preamble also requires that the data storage elements be

> "in one of a first state and a second state."

According to *Candelaria*, the track information block shows a distinction between modified and unmodified records.[3] Thus, in *Candelaria*, the records are "in one of a first state [modified] and a second state [unmodified]." This makes the Examiner's position, namely that *Candelaria*'s

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[2] First Office Action, page 2.

[3] *Candelaria*, col. 7, lines 23-27 ("In the first preferred embodiment, a process accessing records listed in the TIB adds information relating to modification status of the record images. If a record image has been modified, but not destaged to DASD, it is listed as a modified record in the TIB")

tracks and records correspond respectively to claim 1's "data storage units" and "data storage elements," a reasonable one that is entirely consistent with the claim's preamble.

A difficulty arises, however, with the Examiner's assertion that *Candelaria*'s track information block corresponds to claim 1's

"data structure having an entry corresponding to said data storage *unit*."

According to *Candelaria*, the entries of the track information block correspond to *records*. But according to the Examiner's position, each of *Candelaria*'s records corresponds to a "constituent data storage element," not to a "data storage unit." Therefore, *Candelaria*'s track information block actually has entries corresponding to data storage *elements* (i.e. *Candelaria*'s records), not to data storage units (*Candelaria*'s tracks).

Claims 13 and 25 recite limitations similar to claim 1 and are patentable for at least the same reasons.

SECTION 102(b) REJECTION OF CLAIMS 3, 6, 15, 18 and 26

Claim 3 recites the additional limitation of locking the data structure before modifying the status information and unlocking the data structure after modifying the status information.

The Examiner suggests that *Candelaria* teaches locking the track information block before and after modifying status information. As evidence that *Candelaria* teaches locking the track information block, the Examiner cites col. 9, lines 7-46.

The cited passage identifies five structures that are subject to locks. The track information block is not included in this list of five locked structures. Therefore, to the extent the track information block is regarded as claim 1's data structure, *Candelaria* fails to teach the limitation of locking and unlocking the data structure under the circumstances identified in claim 3.

Claims 5, 6, 15, 18 and 26 recite limitations similar to claim 3 and are patentable for at least the same reason.

SECTION 102(b) REJECTION OF CLAIMS 8, 20 and 27

Claim 8 recites the additional limitation of having a data storage unit be a cylinder and having the data storage element be tracks within the cylinder.

Candelaria describes a track information block as a table with entries corresponding to records in a track.[4] There is no indication in this description that the track information block has entries corresponding to cylinders, rather than records.

The Examiner draws attention to the following text, in which *Candelaria* uses the word "cylinder":

> The process of FIG. 5, including steps **146** to **154** can then be substituted for steps **142** and **144** above. In some systems redundant records exist in an out of synchronization cylinder range. Existence of such a range is verified at step **148**. If all the tracks test is valid step **150** we may destage the tracks from the out of synchronization cylinder range (step **152**). Failure of such verification will require reinitialization of the cache as indicated by step **154**.[5]

Applicant does not dispute the fact, at the time of the invention, it was known to divide a disk into cylinders. But claim 8 does not purport to claim cylinders. Claim 8 recites providing a data structure having an entry corresponding to a cylinder, with that entry having status information indicating whether a constituent track of that cylinder is in a particular state. The foregoing passage fails to teach or suggest such a limitation.

Claims 20 and 27 include limitations similar to claim 8 and are therefore patentable for at least the same reasons.

SECTION 102(b) REJECTION OF CLAIMS 5, 9, 21 AND 28

Claim 9 recites the additional limitation that one of the states indicates the presence of invalid data on a track.

The Examiner has cited column 8, lines 7-34 of *Candelaria* as teaching this claim limitation. This paragraph refers to "incongruities" between entries in the track information

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[4] *Candelaria*, col. 7, lines 15-29.
[5] *Candelaria* col. 8, lines 59-63.

block and directory entries. But the track information block is not the track, and neither is the directory entry. Hence, an incongruity between an entry in a track information block and a directory entry does not mean that there is invalid data on the track.

It is clear therefore that *Candelaria* fails to teach or suggest the additional limitation of claim 9. Claims 21 and 28 recite similar limitations and are therefore patentable for at least the same reasons.

SECTION 102 REJECTION OF CLAIMS 11 and 23

Claim 11 recites the additional limitation of scanning a data structure to locate constituent data elements in the first state. When translated into the context of *Candelaria*, claim 11's additional limitation requires a teaching that the track information block be scanned to locate records that are modified (or unmodified).

As support for the proposition that *Candelaria* teaches scanning the track information block to locate records having a particular state, the Examiner draws attention to the following passage:

> "The directory entry is a control block which indicates location of a track image in cache and the address in DASD [Direct Access Storage Device (e.g. disk)] of the unmodified track."[6]

The cited passage merely states that there is something called a "control block" whose function is to show where in the cache one would find a track image, and what the corresponding address of that track, in its unmodified form, would be on the disk drive. The above passage fails to mention, or even allude to, the track information block. It is therefore difficult to see how it can possibly teach scanning the track information block.

Claim 23 recites limitations similar to claim 11 and is therefore patentable for at least the same reasons.

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[6] *Candelaria*, col. 7, lines 16-18.

SECTION 102 REJECTION OF CLAIMS 12 AND 24

Claim 12 recites the additional limitation of detecting an entry in the data structure that indicates the presence, in the data storage unit associated with that data structure, of a data storage element in a particular state, and then scanning the data storage elements in the data storage unit to identify the data storage element in that state.

Translated into the context of *Candelaria*, this would amount to detecting an entry in the track information block that indicates the presence of a track having a modified record, and then scanning the records in that track to identify the particular modified record.

As support for the proposition that *Candelaria* teaches the additional limitation of claim 12, the Examiner draws attention to a first passage at col. 7, lines 16-27, and a second passage at col. 7, lines 31-32.

The first passage describes the function of the track information block as indicating, for each record in the track, whether that record has been modified but not yet destaged. At best, this information indicates that somewhere in the track there exists a modified record. But this does not mean records in the track must necessarily be scanned to identify modified records in that track.

The second passage merely indicates that any process that accesses records that are listed in the track information block will indicate, in the track information block, whether it has modified any of those records. This does not amount to a teaching of scanning records in that track to identify the modified records.

Claim 24 recites limitations similar to claim 12 and is therefore patentable for at least the same reasons.

SUMMARY

No fees are believed to be due in connection with the filing of this supplemental appeal brief. However, to the extent fees are due, or if a refund is forthcoming, please adjust our Deposit Account No. 06-1050, referencing Attorney Docket No. 07072-946001.

Respectfully submitted,

Date: 9/10/07

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Appendix of Claims

1. In a data-storage system having a data storage unit that includes at least two constituent data storage elements, each of said constituent data storage elements being in one of a first state and a second state other than said first state, a method comprising:

providing a data structure having an entry corresponding to said data storage unit, said entry including status information indicating whether at least one constituent data storage element of said data storage unit is in said first state; and

updating said entry following a change in state of at least one of said constituent data storage elements.

2. The method of claim **1**, wherein updating said entry comprises:

identifying an entry in said data structure corresponding to a data storage unit that includes a constituent data storage element in said first state;

modifying status information in said entry to indicate that said data storage unit includes at least one constituent data storage element in said first state.

3. The method of claim **2**, further comprising locking said data structure before modifying status information and unlocking said data structure after modifying status information.

4. The method of claim **2**, wherein modifying status information comprises inspecting said status information to determine if said status information already indicates that at least

one constituent data storage element is in said first state.

5. The method of claim **1**, wherein updating said entry comprises:

detecting that a constituent data storage element is in said second state;

determining whether said data storage unit contains any constituent data storage element in said first state;

identifying an entry in said data structure corresponding to a data storage unit that includes said constituent data storage element;

modifying status information in said entry to indicate that no constituent data storage elements of said data storage unit are in said first state.

6. The method of claim **5**, further comprising locking said data structure before modifying status information and unlocking said data structure after modifying status information.

7. The method of claim **5**, wherein modifying status information comprises inspecting said status information to determine if said status information already indicates that all constituent data storage elements are in said second state.

8. The method of claim **1**, further comprising selecting said data storage unit to be a cylinder and selecting said constituent data storage elements to be tracks included in said cylinder.

9. The method of claim **8**, further comprising selecting said first state to indicate the

presence of invalid data on said track.

10. The method of claim **8**, wherein providing a data structure comprises providing a bit map having a plurality of bits, each of which corresponds to a cylinder, each bit having a first state indicating that at least one track in said cylinder includes invalid data and a second state indicating that no tracks in said cylinder include invalid data.

11. The method of claim **1**, further comprising scanning said data structure to locate constituent data storage elements in said first state.

12. The method of claim **11**, wherein scanning said data structure comprises:

detecting an entry in said data structure that indicates the presence, in said data storage unit associated with said data structure, of at least one constituent data storage element in said first state; and

scanning constituent data storage elements included in said data storage unit to identify said constituent data storage element in said first state.

13. A computer-readable medium having software for execution in a data-storage system having a data storage unit that includes at least two constituent data storage elements, each of said constituent data storage elements being in one of a first state and a second state other than said first state, said software comprising instructions for:

providing a data structure having an entry corresponding to said data storage unit, said entry including status information indicating whether at least one constituent data storage element of said data storage unit is in said first state; and

updating said entry following a change in state of at least one of said constituent data storage elements.

14. The computer-readable medium of claim **13**, wherein said instructions for updating said entry comprise instructions for:

identifying an entry in said data structure corresponding to a data storage unit that includes a constituent data storage element in said first state;

modifying status information in said entry to indicate that said data storage unit includes at least one constituent data storage element in said first state.

15. The computer-readable medium of claim **14**, wherein said software further comprises instructions for locking said data structure before modifying status information and unlocking said data structure after modifying status information.

16. The computer-readable medium of claim **14**, wherein said instructions for modifying status information comprise instructions for inspecting said status information to determine if said status information already indicates that at least one constituent data storage element is in said first state.

17. The computer-readable medium of claim **13**, wherein said instructions for updating said entry comprise instructions for:

detecting that a constituent data storage element is in said second state;

determining whether said data storage unit contains any constituent data storage element in said first state;

identifying an entry in said data structure corresponding to a data storage unit that includes said constituent data storage element;

modifying status information in said entry to indicate that no constituent data storage elements of said data storage unit are in said first state.

18. The computer-readable medium of claim **17**, wherein said software further comprises instructions for locking said data structure before modifying status information and unlocking said data structure after modifying status information.

19. The computer-readable medium of claim **17**, wherein said instructions for modifying status information comprise instructions for inspecting said status information to determine if said status information already indicates that all constituent data storage elements are in said second state.

20. The computer-readable medium of claim **13**, wherein said software further comprises instructions for selecting said data storage unit to be a cylinder and selecting said constituent data storage elements to be tracks included in said cylinder.

21. The computer-readable medium of claim **20**, wherein said software further comprises instructions for selecting said first state to indicate the presence of invalid data on said track.

22. The computer-readable medium of claim **20**, wherein said instructions for providing a data structure comprise instructions for providing a bit map having a plurality of bits, each of which corresponds to a cylinder, each bit having a first state indicating that at least one track in said cylinder includes invalid data and a second state indicating that no tracks in said cylinder include invalid data.

23. The computer-readable medium of claim **13**, wherein said software further comprises instructions for scanning said data structure to locate constituent data storage elements in said first state.

24. The computer-readable medium of claim **11**, wherein said instructions for scanning said data structure comprise instructions for:

detecting an entry in said data structure that indicates the presence, in said data storage unit associated with said data structure, of at least one constituent data

storage element in said first state; and

scanning constituent data storage elements included in said data storage unit to identify said constituent data storage element in said first state.

25. A data-storage system comprising:

a data storage unit that includes at least two constituent data storage elements, each of said constituent data storage elements being in one of a first state and a second state other than said first state;

a memory element configured to hold a data structure having an entry corresponding to said data storage unit, said entry including status information indicating whether at least one constituent data storage element of said data storage unit is in said first state.

26. The data-storage system of claim **25**, further comprising a lock for locking said data structure to prevent modification of said status information.

27. The data-storage system of claim **25**, wherein said data storage unit comprises a cylinder and said constituent data storage elements comprise tracks included in said cylinder.

28. The data-storage system of claim **27**, wherein said first state indicates the presence of invalid data on said track.

29. The data-storage system of claim **27**, wherein said data structure comprises a bit map having a plurality of bits, each of which corresponds to a cylinder, each bit having a first state indicating that at least one track in said cylinder includes invalid data and a second state indicating that no tracks in said cylinder include invalid data.

Evidence Appendix

None.

Related Proceedings Appendix

None.